

March 18-20  
2010

# BIO REU PI Workshop



BIO REU Leadership Committee  
2010

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**DISCLAIMER:** Any opinions, findings, conclusions, or recommendations expressed in this report are those of the participants, and do not necessarily represent the official views, opinions, or policy of the National Science Foundation.

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## **BIO REU Workshop 2010**

## EXECUTIVE SUMMARY

A workshop for principal investigators of Research Experiences for Undergraduate sites funded by the Biological Sciences Directorate at the National Science Foundation was held on 18-20 March 2010 at the Holiday Inn Roslyn Keybridge. The theme of the meeting was “Enhancing Communication and Best Practices through Networking”. 145 representatives from sites across the U.S. as well as several guests from the National Science Foundation and experts in responsible conduct of research, undergraduate research and learning, and undergraduate research learning assessment attended. A poster session led by REU PIs opened discussion and networking on topics ranging from best practices in responsible conduct of research (RCR) training to recruiting strong cohorts. An evening keynote on March 18 opened discussion on strategies for integrating research throughout the undergraduate curriculum. During the following days guest speakers introduced topics including RCR training and program assessment and evaluation. Participants broke into small discussion groups to discuss specific questions related to recruitment, training, RCR, assessment, and best practices and reported back to the large group. Discussions were specifically focused on recommendations for the development of shared resources for RCR training, program assessment, recruitment, sharing and recognizing student, mentor, and program success. Specific recommendations are targeted to the BIO REU Leadership Committee (LC) and the REU community as a whole.

The 2010 BIO REU workshop was the third workshop held for BIO REU PIs. The first (Sep 24-26, 2003) was a combined REU and UMEB PI and hosted 140 participants + practitioners as was held at NSF. The second was held in March 2007 and hosted 133 BIO REU PIs and 10 speakers and NSF staff and was also held at NSF. The March 2007 meeting included a poster session on Best Practices and included “clicker” surveys of participants. In March 2010 the BIO REU Leadership Committee (LC) which was established as a result of the 2007 workshop surveyed registrants prior to the meeting. In 2010 the meeting hosted 149 PIs, and 10 speakers and NSF staff. At the 2010 meeting we focused on specifics related to the America COMPETES Act (Responsible Conduct of Research and Assessment).

## Recommendations to LC

### Training in Ethics and Responsible Conduct of Research

1. Establish a committee of Bio REU PIs to:
  - a. Define a small set of core topics in ethics and RCR to be taught by all Bio REU programs
  - b. Identify/develop the resources that PIs need to teach those topics
  - c. Identify/develop an common assessment tool to document successful completion of core training
2. Offer a certificate to students who complete the core training
3. Create a space on the Bio REU website for the core topic materials identified by the committee and for PIs to share best practices and resources for ethics and RCR training

### Support of Assessment Needs

1. Establish an assessment committee of Bio REU PIs to:
  - a. Identify needs of BIO REU program sites for assessment support and coordination
  - b. Develop plans for meeting these needs through
    - i. Developing a common assessment tool and implementation system for documenting Define a set those outcomes of common outcomes that all Bio REU programs should be achieving that can be measured with such a tool
    - ii. Building resources on the BIO REU Website, and through workshops and other activities, that support sites' assessment activities to maximize efficiency and quality
    - iii. Making recommendations for what the on-going needs for site-based assessments are, and how these can be supported.
  - c. Evaluate the SURE and URSSA teams and their surveys to determine which is best suited for Bio REU and identify or add (if necessary) core questions that assess the common outcomes.
2. Make recommendations for activities that will address BIO REU assessment needs, based on the work of the committee
3. Continue to support these efforts

### Additional Recommendations to LC

1. Develop a mechanism to recognize outstanding mentors
2. Create a space on the Bio REU website for the core topic materials identified by the committee and for PIs to share best practices and resources for ethics and RCR training
3. Create greater transparency concerning the LC, including well-defined roles and responsibilities, as well as a transparent process by which new LC members are chosen.
4. Consider development of regional REU conferences to highlight student work and facilitate participation of students in scientific meetings

### Training in Ethics and Responsible Conduct of Research (RCR)

1. Communicate with and provide feedback to the Ethics/RCR Bio REU committee formed by the LC to ensure that the work it does meets the expectations of the American COMPETES Act.

### Common Assessment Tool to Measure BIO REU Outcomes

1. Communicate with and provide feedback to the Assessment Bio REU committee formed by the LC to ensure that the core outcomes data needed to support efforts to secure funding for the REU program are included.
2. Provide support for the development and implementation of the common assessment.

3. Provide support for site-based assessment efforts that complement the common assessment and are necessary for program improvement.
4. Determine to what extent NSF will fund the LC to maintain website
5. Continue the summer survey and include 5 basic questions to capture cross-REU assessment data
6. Support BIO REU committee efforts on Ethics/RCR, Assessment and Student Travel
7. Provide funds to support more frequent meetings of REU PIs whether national or regional.

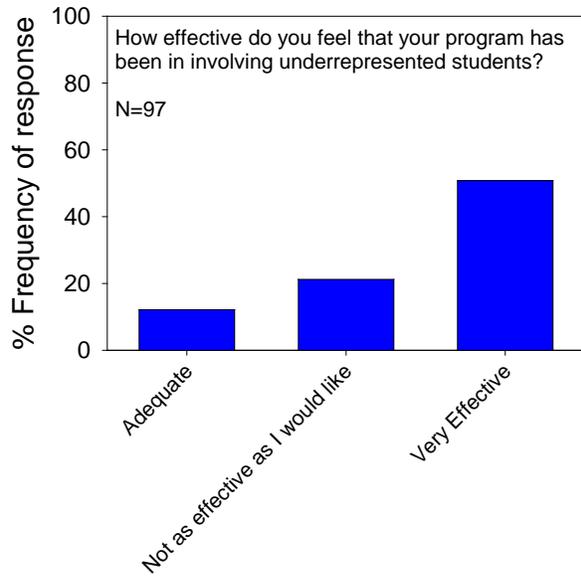
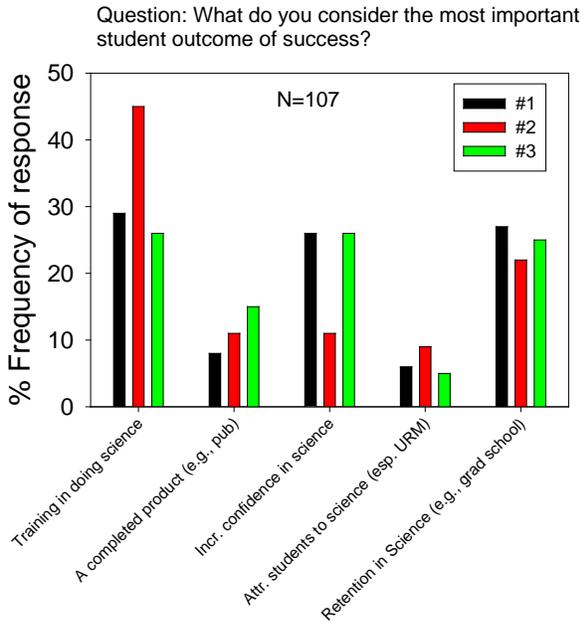
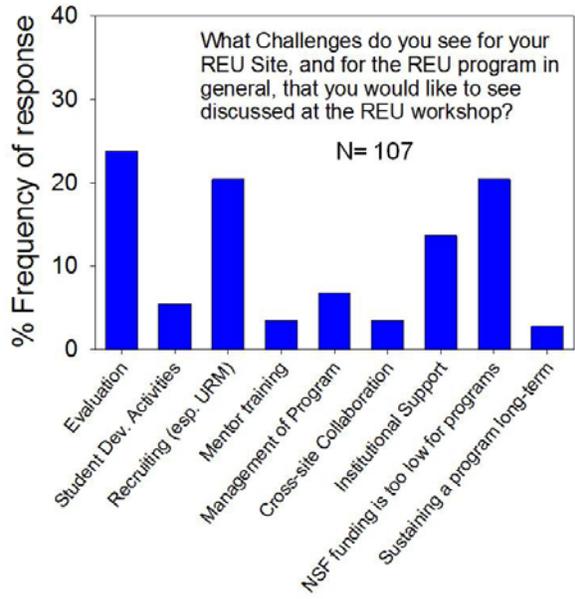
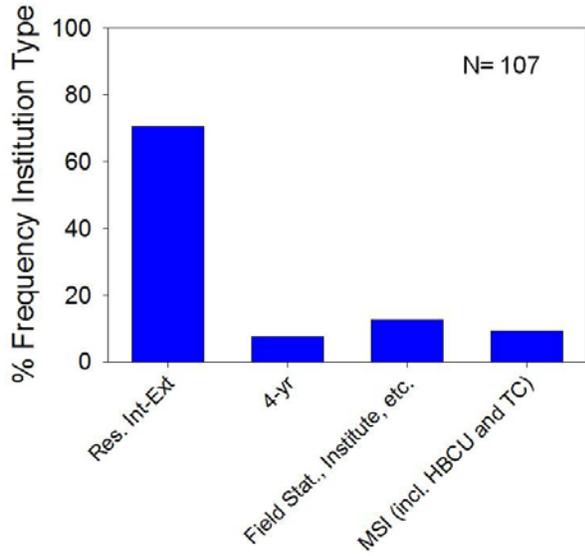
### **Recommendations to the REU Community as a Whole**

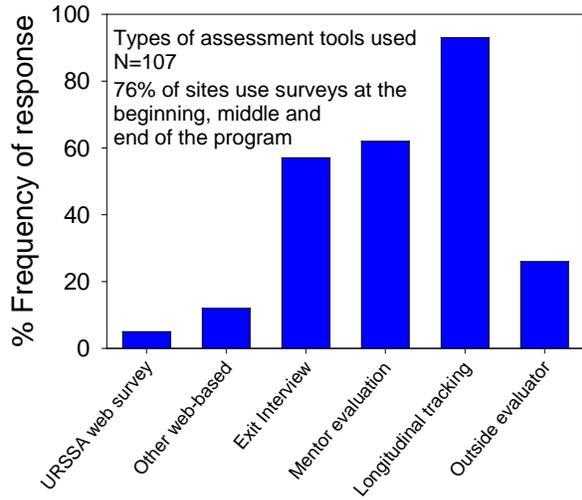
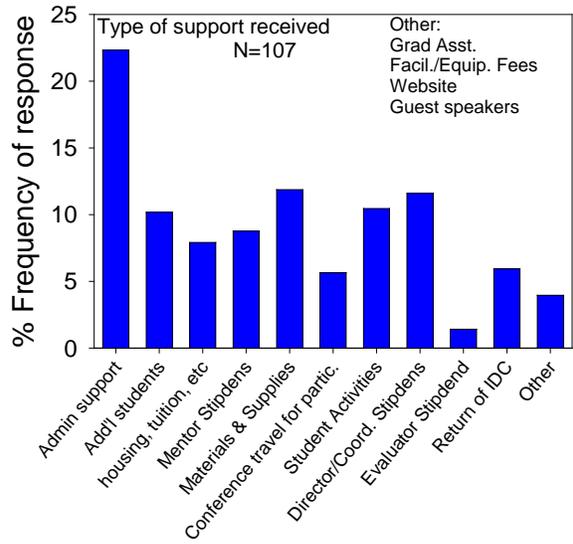
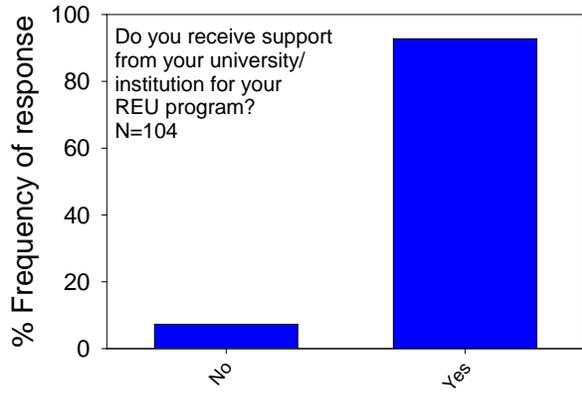
1. Participate actively in the efforts to identify best practices, develop standards of excellence for RCR and ethics training in BIO REU contexts, and develop an effective, efficient and responsive assessment system.
2. Articulate visions for success and share documented examples of its attainment.

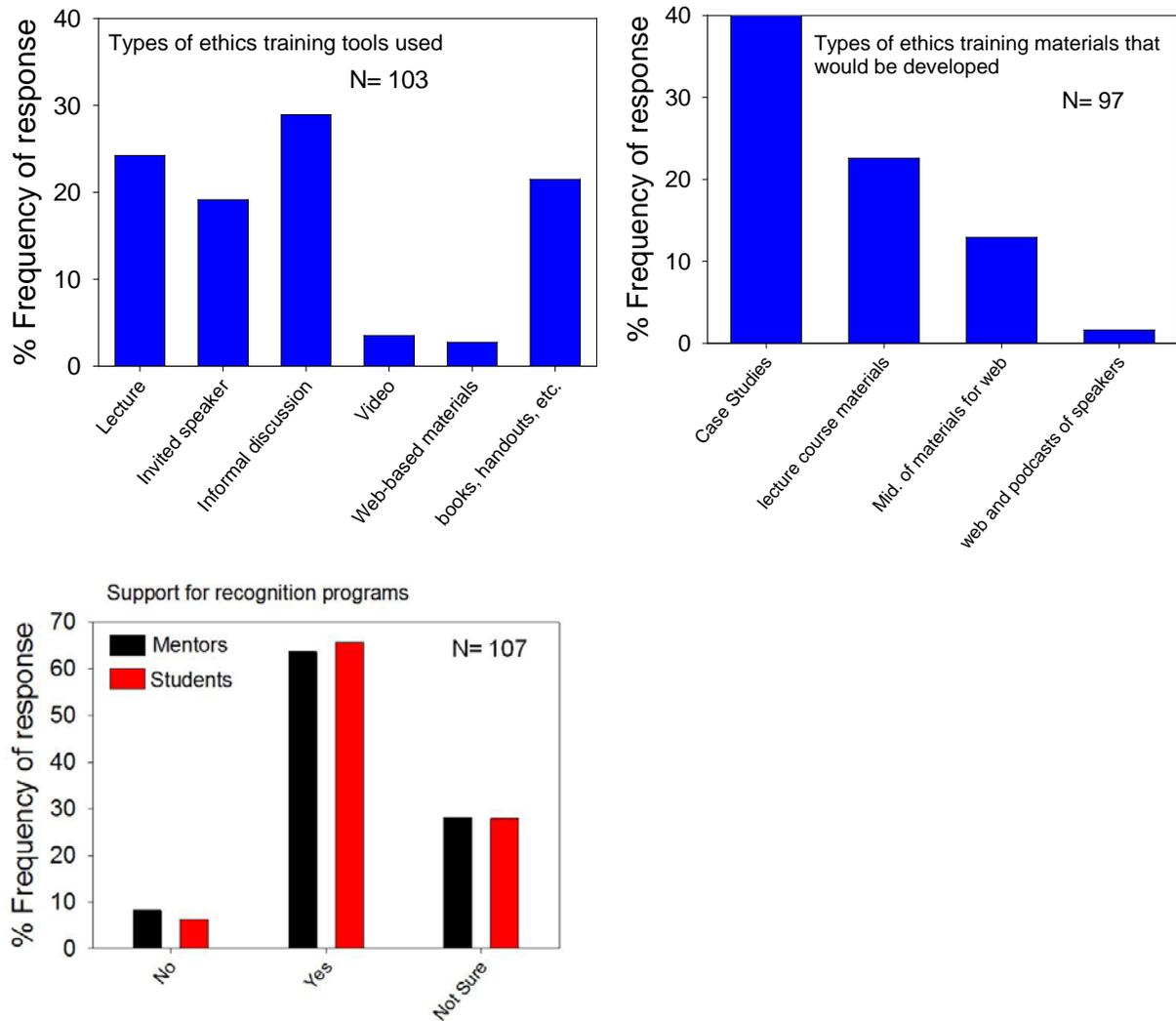
## Information about the Attendees and the Agenda

Prior to the meeting a pre-registration survey was developed and PIs were asked to complete this survey through the BIO REU website (<http://www.bioreu.org/node/14>) (Figure 1).

We asked PIs to answer questions that guided the development of the workshop Agenda. Based on the results of the survey we developed the Agenda shown in Table 1. A full registrant list can be found at the end of this report in Table 3.







**Figure 1.** Summary of pre-registration survey results. Results of this survey were used by the Leadership Committee to develop the Agenda shown in Table 1.

**Table 1.** Agenda of the BIO REU Workshop.

<b>Thursday, March 18</b>	
2:00 PM - 6:00 PM	<b>REGISTRATION AND BADGE PICKUP (Promenade)</b>
3:30 PM - 4:00 PM	<b>POSTER SET UP (Shenandoah)</b>
4:00 PM - 5:00 PM	<b>POSTER SESSION 1 (Posters 1-20)</b>
5:10 PM - 6:10 PM	<b>POSTER SESSION 2 (Posters 21-40)</b>
6:10 PM - 6:30 PM	<b>POSTER TAKE DOWN</b>
7:00 PM - 8:30 PM	<b>DINNER (Vantage Point Rooftop Restaurant)</b> <b>Gabriela C. Weaver, Ph.D., Purdue University</b> <i>"The role of undergraduate research in undergraduate science education"</i>
<b>Friday, March 19</b>	
7:30 AM - 8:30 AM	<b>CONTINENTAL BREAKFAST (Rosslyn Ballroom)</b>
8:30 AM - 9:00 AM	<b>WELCOME AND MEETING GOALS</b> <b>Robyn Hannigan (Leadership Committee Chair)</b> <b>Sally O'Connor, NSF BIO/DBI Program Director</b> <b>Peter Arzberger, NSF BIO/DBI Division Director</b>
9:00 AM - 9:30 AM	<b>SUMMARY OF PRE-MEETING SURVEY</b>
9:30 AM - 10:45 AM	<b>PLENARY SESSION 1: <i>REU Ethics Training</i></b> <b>Francis Macrina, Ph.D., Virginia Commonwealth University</b> <i>"Engaging Undergraduates in the Responsible Conduct of Research Training"</i>
10:45 AM - 10:50 AM	<b>INSTRUCTIONS ON BREAKOUT SESSIONS</b>
10:50 AM - 11:00 AM	<b>AM BREAK (Beverages and Light Snacks)</b>
11:00 AM - 12:00 PM	<b>BREAKOUT SESSION 1: <i>REU Best Practices and Issues (1)</i></b> Attendees – see breakout session participant lists in your registration packet for your assigned room
12:00 PM - 12:45 PM	<b>WORKING LUNCH (Box Lunch Provided)</b>
12:45 PM - 1:00 PM	<b>Diana Anderson, NSF BIO/DBI Program Director</b> Ethics Training and REU Programs
1:00 PM - 2:45 PM	<b>PLENARY SESSION 2: <i>Assessing Outcomes of REU Programs</i></b> <b>Sandra Laursen, Ph.D., University of Colorado – Boulder</b> <i>"Student Self-Assessment and Research Learning Gains"</i> and URSA <b>David Lopatto, Ph.D., Grinnell College</b> <i>"The Survey of Undergraduate Research Experiences (SURE)"</i>
2:45 PM - 2:55 PM	<b>PM BREAK (Beverages and Light Snack)</b>
2:55 PM - 4:05 PM	<b>SMALL GROUP DISCUSSIONS: <i>"REU Future Plans and Sustainability"</i></b> <i>Ethics and the responsible conduct of research training</i> <i>Assessment of REU outcomes (including common assessment tool)</i> Attendees – see breakout session participant lists in your registration packet for your assigned room
4:05 PM – 4:15 PM	<b>RETURN TO LARGE GROUP</b>
4:15 PM - 5:30 PM	<b>PLENARY DISCUSSION: <i>Ethics and the responsible conduct of research training, and assessment of REU outcomes (including common assessment tool)</i></b> Reports from small groups, Questions, and Discussion
5:30 PM – 6:00 PM	<b>ANNOUNCEMENTS</b>

**6:00 PM** **ADJOURN FOR DAY (Dinner on your own)**  
PIZZA meeting - presentation by Bob Powell (Avila University)  
“Publishing with undergraduate REU participants – tips and strategies”

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**Saturday, March 20**

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**7:30 AM - 8:30 AM** **HOT BREAKFAST (Vantage Point Rooftop Restaurant)**  
**8:30 AM - 9:15 AM** **PLENARY SESSION 3: *REU Future Plans and Sustainability***  
**Alan Savitzky and Diana Anderson**, NSF BIO/DBI Program Directors  
**Lida Beninson**, *Biology REU Sites: Summer of 2009*  
**Jairo Pava**, *REU website*

**9:15 AM - 9:30 AM** **AM BREAK (Beverages and Light Snacks)**  
**9:30 AM - 10:30 AM** **BREAKOUT SESSION 2: *REU Best Practices and Issues (2)***  
Attendees – see breakout session participant lists in your registration packet for your assigned room

**10:30 AM - 10:40 AM** **RETURN TO LARGE GROUP**  
**10:40 AM - 12:00 PM** **BREAKOUT SESSION REPORTING**  
Group Facilitators and Reporters summarize results from sessions 1 and 2 Discussions

**12:00 PM - 12:30 PM** **FINAL REMARKS**  
**12:30 PM** **MEETING ADJOURNED**

The following report summarizes the activities at the meeting including the results of the breakout group discussions and recommendations to the Leadership Committee and the BIO REU community at large.

## The Poster Session

Thirty participants presented posters on subjects ranging from best practices in recruiting to assessment and RCR training. Abstracts for the posters are available on-line at <http://www.bioreu.org/node/7>. PDFs of the posters will be made available to the public through the BIO REU website. Posters serve to capture best practices of REU programs (Table 2).

**Table 2.** Presenters and titles of posters presented at the workshop.

<b>First Name</b>	<b>Last Name</b>	<b>Poster Title</b>
Tamim	Younos	<a href="#"><u>Overview of REU Site Assessment Tools and Outcomes</u></a>
Aaron	Ellison	<a href="#"><u>Long-term impacts of the Harvard Forest REU Site</u></a>
George	O'Toole	<a href="#"><u>REU Program in Molecular and Cellular Biology at Dartmouth</u></a>
Elica M.	Moss	<a href="#"><u>Mentoring 21st Century Scientists in Environmental and Natural Resource Sciences: A National Science Foundation Research Experiences</u></a>
John	Wallace	<a href="#"><u>NSF-REU programs: How undergraduate student research in aquatic ecology can survive</u></a>
Patricia	Kelley	<a href="#"><u>REU in Biodiversity Conservation: a multidisciplinary, collaborative approach to undergraduate research</u></a>
Paul	Bosland	<a href="#"><u>Underrepresented Hispanic Migrant Students Succeed Through Agricultural Science</u></a>
T'ai	Roulston	<a href="#"><u>The REU Program at the University of Virginia's Blandy Experimental Farm</u></a>
Mark	Running	<a href="#"><u>Enrichment Components in the Summer REU Program at the Donald Danforth Plant Science Center</u></a>
Benoit	Dayrat	<a href="#"><u>REU Site: Yosemite Research Training in Environmental Science</u></a>
Jeremy	Guinn	<a href="#"><u>ND Tribal College REU Program 2009: Research Experiences for Undergraduates in Ecology</u></a>
Emilia	Martins	<a href="#"><u>Successful Research Experiences in Animal Behavior</u></a>
Brozik	James	<a href="#"><u>WSU REU: Chemical and Physical Characterization of Biological Systems</u></a>
Mary	Cloninger	<a href="#"><u>Mountains and Minds</u></a>
Janet	Schottel	<a href="#"><u>Student Recruitment for the Summer REU Program at the University of Minnesota</u></a>
Carmen	Domingo	<a href="#"><u>SFSU REU Program in Ecological Evolutionary Developmental Biology</u></a>
Omar	Oyarzabal	<a href="#"><u>Interdisciplinary Studies for Sensor and Biosensor Development</u></a>
Gwen	Sancar	<a href="#"><u>REU in Molecular Biosciences at the University of North Carolina at Chapel Hill: An Integrative Science Experience</u></a>
Van A.	Doze	<a href="#"><u>Providing Research Experiences for Undergraduates (REU) from Rural and Tribal Colleges</u></a>
David	Pfeiffer	<a href="#"><u>Assessing the effectiveness of REU Program recruiting strategies at the University of Alaska Anchorage</u></a>
Michelle	Whaley	<a href="#"><u>Enriching the REU Experience</u></a>
Rachel	Skvirsky	<a href="#"><u>REU Ethics Training at UMass Boston.</u></a>

Georg	Jander	<a href="#">Web-Based Submission and Evaluation of REU Applications</a>
Alonso	Ramirez	<a href="#">Undergraduate research training in tropical ecology in Puerto Rico</a>
Diane	Neudorf	<a href="#">Research Experience for Undergraduates in Experimental Field Biology at Sam Houston State University</a>
Eric	Nagy	<a href="#">Independent Field Research in Ecology, Evolution and Behavior at Mountain Lake Biological Station</a>
Michelle	Evans-White	<a href="#">Minority student recruitment strategies for REU programs</a>
Paul	Laybourn	<a href="#">Minority Under Representation in Science: Why, should we care, and can we fix it?</a>
Paul	Blum	<a href="#">NSF REU Site: Bioenergy Systems – Integrating Institutional Approaches in Nebraska</a>
Tai	Roulston	<a href="#">The REU Program at the University of Virginia's Blandy Experimental Farm</a>
David	Berg	<a href="#">Students Grow as Scientists and Citizens through REU Enrichment Activities</a>
John	Barthell	<a href="#">An REU Program in Turkey: Students Studying Biological Invasions within a Global Context</a>
David	Hackney	<a href="#">The Carnegie Mellon REU: Undergraduate Research Experiences in Cellular &amp; Molecular Biosciences</a>
Kurt	Regner	<a href="#">A Broad View of Environmental Microbiology at UNLV</a>

## Keynote Speaker – Dr. Gabriela Weaver

Dr. Gabriela Weaver (Purdue University) discussed the role of undergraduate research in the curriculum and unique pedagogical approaches to integrating research experiences across the science curriculum. As the PI of the NSF-funded Center for Authentic Science Practice in Education (CASPiE; <http://www.purdue.edu/dp/caspie/>) project, Dr. Weaver presented results of several years of curriculum development and assessment of curricula for integration into the chemical, biological, and geological science curriculum at both 2-yr and 4-yr institutions. Her results demonstrate the value of integrating research into traditional courses, with the CASPiE courses showing significant impacts on student learning but also on student retention in the sciences.

## Welcome and Meeting Goals

Dr. Robyn Hannigan (Chair, Leadership Committee) opened the meeting with an overview of the agenda and the goals of the meeting that were to specifically address the needs of the community for RCR training materials and for the development and implementation of assessment tools, including the potential for a common assessment tool or tools. Dr. Sally O'Connor (BIO/DBI Program Officer) further

elucidated the goals of the meeting and set in context the funding history and future of the REU program. Dr. Peter Arzberger (BIO/DBI Division Director) welcomed the participants and the need for community guidance regarding leveraging common resources and providing assessment-based support for the impact of REU experiences on students. Presentations of non-NSF speakers are available on the BIO REU website.

### *Plenary Session 1: REU Ethics Training*

**Keynote Speaker - Francis Macrina, Ph.D., Virginia Commonwealth University, “Engaging Undergraduates in the Responsible Conduct of Research Training”**

The America COMPETES Act signed in 2007 requires that all students supported by NSF on undergo ethical conduct training. Dr. Macrina’s presentation focused on how to best teach responsible conduct of research (RCR) to undergraduate students who usually come into a research experience with limited to no previous exposure in ethical conduct training. In the short amount of time that REU students have available for RCR training, they need to learn how to develop and identify best practices in scientific research, such as proposing, performing, reporting, and reviewing. Those best practices need to be applied consistently and habitually, and there needs to be a system in place for taking actions against RCR transgressions.

Fortunately, for PIs uncomfortable with compiling their own ethics training, there are numerous resources available from:

- Office of Research Integrity
- Online Ethics Center
- Ethics in Science and Engineering National Clearinghouse
- Project for Scholarly Integrity
- Science, Technology and Society Initiative

It is important to note that the content of the RCR training should be reflective of and appropriate to the line of research conducted and the research institution. Students should walk away from their REU experience with the feeling that the scientific community is a professional culture of right and wrong with codes of norms. To measure the success of the RCR training, PIs can administer student evaluations that require identification of ethical violations. However RCR is taught, the program should be engaging, challenging, and evaluative. A Small Group breakout discussion session in the afternoon focused on RCR training and community resource development.

### **Breakout Session #1**

The first breakout session engaged small groups in sharing and discussing best practices in key areas of REU program delivery: a) recruitment, b) student training, c) mentor training and support, and d) institutional support. Each group was asked to consider:

- 1) What community resources, common materials, tools etc. could be shared on the BIO REU website?
- 2) Are there assessment/evaluation aspects to the breakout topic that could be captured in a common assessment tool?
- 3) What community resources would enable REU programs to better serve students?

In each of the 5 breakout groups participants volunteered for the following tasks:

*Facilitator:* Responsible for keeping the group on topic, ensuring every group member has the opportunity to contribute to the discussion, clarifying and summarizing key points of the discussion, and managing time so that all topics are addressed.

*Note taker:* Responsible for documenting the discussion key points and suggestions.

*Reporter:* Responsible for sharing the key points and suggestions with the large group.

Summary of breakout group discussions: REU PIs agreed that student training should incorporate certain skills that are universal across fields. Some of the common skills students should learn after their REU experience include how to pose questions and write good hypothesis, read and think critically, retrieve relevant information, design an investigation (for experimental research) and critically analyze the data, document their research carefully, and communicate their results effectively. Professional skills that should improve with an REU experience include time management, ethics, and communication with scientists and nonscientists.

### *Recruiting a strong class of students*

#### **Questions**

- What are the most effective strategies for recruiting underrepresented minority students?
  - o What strategies could help programs diversify their student cohort when they are recruiting from a less diverse geographic area?
  - o What recruitment methods work with specific target communities?
- What factors would help you identify students that are genuinely interested in pursuing graduate programs?
  - o What research-based information do you think can be used to improve your recruitment and selection efforts?
- Should REU programs accept pre-professional applicants? Is accepting such applicants in line with the goals of REU Sites?
- What experiences would help students to become prepared for REU summer experiences?
- What tasks would you assign students to help them prepare for REU summer experiences?
- What role can the REU LC provide to support your recruitment and selection efforts?

#### Best Practices

##### *Community Resources Recommendations*

1. Provide a template of on-line applications for REU sites
2. Provide a list of best practices for REU
3. Provide a list of annual professional meetings to which students can attend with mentors including deadlines for abstract submissions

##### *Recruiting Underrepresented Minority Students Best Practices*

1. Visits to Minority Serving Institutions (MSIs)
2. Establish Personal Contacts with Faculty at MSIs
3. Invite Faculty to talk about their career paths
4. Recruit URM students from own institution
5. Direct connections with faculty advisors at MSIs
6. Previous students as ambassadors of the program
7. Interaction between applicants and potential mentors to see if there is a good fit
8. Visit websites and contact program directors
  - a. McNair, MARC/MBRS, LSAMP
9. Recruit at Professional Meetings targeting URM students

- a. Society for the Advancement of Chicanos and Native Americans in Science (SACNAS)
  - b. American Indian Science and Engineering Society
10. Consider recruiting biomedical focused URM students into REU programs early
- a. Research experience may stimulate their interest to pursue graduate programs rather than medical school
  - b. Assign them research projects that will give them knowledge and skills relevant to the biomedical fields
11. Be prepared to provide additional resources, if necessary
- a. Some URM students may need child care expenses, family housing etc.

*Best Practices for identifying students interested in graduate school*

1. Personal statements
2. Letters of recommendation
3. Phone interviews
4. With research experience vs. without (some discussion on relative merits of recruiting students with previous experience vs. no previous experience)

*How do we define a strong class of students?*

1. Diverse in many ways (ethnically, socio-econ, grade level, institution, amount of research experience)
2. Has strong interest/enthusiasm for topic of REU site and mentors
3. Shows evidence of leadership in some members
4. Shows evidence of ability to perform research
5. REU experience will make a difference in personal situation (high impact)

Recommendations

1. Consider first generation students
2. Economically disadvantaged students
3. Students from low income areas

*Student Training*

**Questions**

- What types of common skills do you think most/all REU participants should gain at the end of the experience?
  - o Which of the skills should be taught in general or specialized groups?
- Would you be willing to share development/training workshops with the Bio REU community that can be used by other REU sites?
  - o What types of skill development workshops should be in that collection of best practices?
  - o What role the REU LC can provide to support this sharing?
- What activities/strategies do you think help students to have successful REU research experiences?
  - o How do you qualify success?
- Do your sites use internet social networks to develop/promote/maintain networks between past/present REU student participants/mentors?
  - o What would be the benefit of implementing a social network to your REU program?
- What types of culminating experiences (such as power point presentations or posters) do programs use to showcase students' final results?
  - o Do you provide programmatic activities aimed at developing/improving scientific communication skills? How often? What do you think works best?

- What types of professional development activities you provide to REU student participants that you think have been successful at helping students apply and be admitted to graduate programs?
- What role can the REU LC provide to support your student training efforts?

### Best Practices

Strategies to select mentors?

1. Know the qualities and attributes you need in mentors and which have those qualities
2. Training workshop
3. Be honest and “blacklist” mentors who are not good
4. Make sure to watch over mentors
  - a. Have students assess mentors and site director provide feedback
  - b. Early intervention needs to be available
5. Some sites use personal statement to match “personalities”
6. Be clear with students and mentors on how matches are made
7. Use a consortium of mentors rather than relying on just one
8. The match can occur before summer REU
  - a. One program has option to choose after meeting the faculty. 10 students versus 14 faculty.
  - b. But many faculty think it is a service – others
9. Pre-screen strategies: phone interview, close reading of the personal statement.
  - a. Many students don’t know what they want to do. So ask broadly. Match personality.
  - b. Phone interview to learn about personality. Recommendation letters help to learn about personality.
10. If students only meet with mentor once or twice per week only, intervene by PI.
11. Co-mentoring/ post-doc, graduate student, (but some – less than half - institutions don’t have post-doc or graduate students).

Best Practices - How to cement mentor-student relationship.

1. Feedback to student on regular basis
2. Common activities across cohort that includes mentors
3. Have students present in week 3 (before halfway point)
  - a. 3/5 (3 slides, 5 min) every Thursday. Background for one week, results for another.
  - b. 5 to 6 meetings across 10 week, only interns (not mentors), group evaluation.
    - i. General concerns and what does work.
4. Weekly updates – present with oral or power-presentation, with faculty mentor, lunch, as a way to assess progress.
5. Ask ‘What’s your project’ without warning – give feedback to mentors
6. Students are curious about the personal lives of mentors.
  - a. First week bonding – e.g., BBQ, all week together, not in other labs, then the day at the beach. Car pool to a meeting together. Different mentor per day for the first week. This is all before research activity begins, together with safety training.
7. Mismatch about expectation. Need to talk to both the mentor and student. PI has the role to cement the relationship between mentor-student relationship.

### Recommendations

Mentor Selection

1. Offer best practice information on-line for assessment of mentors, mentor training
2. How can we empower PIs?
3. Assess mentors

- a. How many hours with student?
4. Write a grant as a team, with the intention to get something out of it. Some supplies, some data, summer support.
  - a. The majority will be getting 1 mo summer salary. At the time of writing, the team is formed. But this has to be tied to institutional support. Documented salary support for PI.
  - b. If faculty is not performing, support goes away for the mentor
  - c. Co-mentoring is helpful, b/c coverage is easier

#### Student-Mentor relationship

1. Have mentors write a statement of expectations
2. Have mentors “apply” to the program
3. Have mentors prepare a mentoring plan

#### Rewards or acknowledgement of mentors

1. Recognition of REU mentor participation for junior faculty
2. Use website to enhance recognition of REU programs

#### For the LC to assist in mentoring

1. Work to develop strategies to increase funds available to support mentor stipends (even small amounts go a long way)
2. Work with institutions to enhance recognition of value of effort to induce rewards from institutions (e.g., release time)
3. Increase the # of allowed Co-PIs on REU proposals to ensure recognition of effort at institution

### *Mentor Training and Support*

#### Questions

- What strategies do you utilize to select mentors?
  - o What qualities/attributes do you want in a good mentor?
  - o What training workshops do you think are effective in improving the quality of mentoring?
- What strategies do you think work in terms of matching students with potential mentors?
  - o What types of feedback do you collect from participants and mentors that help you improve your matching?
  - o How have you corrected your process of mentor selection based on previous feedback?
- What activities do you implement to build a positive and nurturing mentoring environment?
  - o Do you integrate common REU cohort activities in your program with discussions of project activities?
  - o Do mentors get feedback during the REU term on their performance?
- What role can the REU LC provide to support your mentor training and support efforts?
- What rewards or acknowledgements does your institution provide for those mentors?

#### Best Practices

1. Defining a mentor is key. In many programs there are levels of mentoring provided not only by the “faculty mentor” but by post-docs and graduate students
2. Best Practices for Selection of Faculty Mentors
  - a. Often, pre-selection of mentors is based on informal discussions and reputation.
  - b. What training workshops are effective in improving the quality of mentoring?
    - i. Many faculty feel they don't need to be trained at being a mentor, especially professors.

- ii. Some programs require a “one hour orientation” session for mentors at the beginning of the program to layout things such as where the students are, what the students need, etc.
        - 1. The idea to this session is that mentors aren't being “trained”, but are getting suggestions for improvement, no matter what stage of mentoring they are at.
    - c. Some feel that access to a standard program for introducing people to mentoring would be useful.
    - d. Some PI's recommended the “Entering Mentoring” program
    - e. It was mentioned that there is a fundamental issue in getting mentors at some sites to actually attend a mentor training session.
      - i. One suggestion was to tell mentors that if they don't attend, they won't get a student.
      - ii. Others feel it is up to the PI to be a cheerleader and make the mentors take it seriously.
        - 1. Also, it was mentioned that student evaluations are particularly useful in identifying areas for improvement in continuing mentors.
    - f. One suggestion was to bring in an outside speaker in order to step past the awkwardness of talking to colleagues about how to mentor their own students.
      - 1. One PI offered a 2 hour workshop, and many people did attend.
        - a. Topics included sensitivity to underrepresented groups, student-mentor communication, motivational methods, student needs, etc.
3. Strategies for matching students
  - a. Some choose the students and then let the mentors pick among the chosen students.
  - b. Others have students pick preferred mentors, mentors pick from students that chose them, and program directors make final decisions to consider diversity representation, etc.
  - c. One interesting issue is that some programs have more mentors than students, and some have many more students than mentors. This largely determines whether the selection process is mentor- or student-driven.
  - d. There was a noted difference between having students rank all of the mentors, or just picking a few to apply with.
  - e. In many cases, mentors write a blurb about the student project prior to student application so that students can choose mentors based on their interests in either the project or in the science itself.
4. What do we need for mentors to build positive and nurturing mentoring environments?
  - a. Mentors should be involved with more program activities besides just the student's projects.
    - i. Could include poster/seminar series throughout the length of the project. Mentors attend these series and therefore have interaction with students outside of the lab.
    - ii. Some programs have a journal club each week as well for both mentors and students.
    - iii. Field station sites often have weekend side trips or social activities, as well as cafeteria meals and shared field work. All of these items include participation of both students and mentors.

- iv. Some programs use the introduction of the student's projects during chalk talks to bring students and mentors together. Mentors tend to get more invested when the student is talking about work in that professor's own lab.
- v. Other programs have a retreat for students and mentors.
- vi. There appears to be great variation in the invested interest level of mentors in different programs. Some PI's seem to need a lot of effort to raise mentor interest in their REU student. Other programs, particularly those at field stations and smaller schools, have fewer issues with this.
- vii. Interesting issues arise with mentor/student interactions when some students are internal (from the host site) or external (visiting).
- viii. Some sites have a weekly meeting between REU students and another representative undergraduate. This undergraduate can act as a "buffer" to help the students open up about issues that they might be intimidating to tell their mentors or the REU coordinator.
- ix. Some sites use a big brother/big sister or life coach model to keep their REUs mentally healthy. This is of particular importance at tribal colleges where students might have more challenges to face during their program.
- x. In sum, any regular, common social meeting outside of the laboratory is useful for strengthening the cohort model, which in turn reflects well on the student-mentor nurturing environment.

### Recommendations

1. Share, through the website, mentor training materials.
2. Through discussion boards share challenges and mentor evaluation methods
3. Share best practices for mentor-student matching through the website and discussion boards
4. The community requests a statement stating that that mentor training is strongly encouraged in a program. This will empower PI's with mentors that seem disinterested in training.
5. Need to know if post-doctoral and graduate students are considered as "mentors", are they encouraged or discouraged?
6. Workshops and powerpoint training materials would be useful for mentoring training, resources posted on-line

### *Institutional support for your REU program*

#### **Questions**

- What recognition does your institution provide for faculty time committed to REU programs?
- What financial support does your institution provide for program mentors and participants?
- Does your institution have a mechanism for incorporating research experience into the broader undergraduate experience?
- What support or barriers do you experience with access to facilities in the recipient institution?
- Do your administrators understand the NSF REU program, its budgets, goals, constraints?
- Do your administrators support your participation in the NSF REU program?

Recommendations are summarized in the section above.

## PLENARY SESSION 2: Assessment and Evaluation

The discussion on Responsible Conduct of Research training was furthered by a presentation by Dr. Diana Elder Anderson (NSF BIO/DBI Program Officer) who presented an overview of goals and objectives Responsible Conduct of Research Training for REU programs and new funding opportunities available for development of RCR training tools.

**Keynote Speaker - Dr. David Lopatto, Ph.D., Grinnell College, "Survey of Undergraduate Research Experiences (SURE)"**

Only recently have attempts been made to establish a set of benefits generated by undergraduate research experiences. In 2003 David Lopatto designed the SURE survey, a research tool for assessing the impact of undergraduate research on student learning, with funding from Howard Hughes Medical Institute. Since its generation, David has collected over 10,000 SURE surveys from various undergraduate summer research programs. His research has reported gains on 20 potential benefits of undergraduate research experiences.

The SURE survey is comprised of the following:

- General information
- Demographics
- Mentor/mentee evaluation
- Prior experience
- Post-graduate plans before and after the experience
- Comments on summer research versus academic year research
- 21 learning gains items
- Evaluation of summer program components

The survey is filled out anonymously and takes approximately ten minutes. If the PI would prefer to opt out of confidential submission, they must get approval from their school ethics committee. The PI can view the survey data in distributions and they can even have the student mentors can rate their own experience. The SURE survey is currently available at <http://web.grinnell.edu/sureiii/>.

**Keynote Speaker - Dr. Sandra Laursen, Ph.D., University of Colorado Boulder, "Student Self-Assessment and Research Learning Gains"**

Sandra Laursen has also investigated the outcomes of undergraduate research experiences through the web-based survey called Undergraduate Research Student Self-Assessment, or URSSA. URSSA was developed in response to campus needs for a tool for assessing research-based learning outcomes that is reliable, simple to use, and cheap, or standardized. The survey focuses on what students gain from a course and from specific instructional activities.

The URSSA survey is comprised of the following:

- Graduate school matriculation and publication rates
- Student presentations
- Skills acquired (lab work and communication)
- Conceptual knowledge and linkages in their field
- Understanding the intellectual and practical work of science
- Growth in confidence, adoption of an identity as a scientists

- Prep for a scientific career or graduate study
- Gains in understanding
- Personal gains

While the survey is longer than SURE, it is easily customizable by the REU PI. The data can be analyzed for each individual REU site, but it can also be pooled from all REU sites. The URSSA survey is currently available at <http://www.colorado.edu/eer/research/undergradtools.html>.

### Small Group Discussions

Small groups were assigned to discuss two main issues as outlined below. Each group discussed both topics.

- 1) How do we best support implementation of ethics and the responsible conduct of research training for all REU students?
- 2) How do we ideally develop and implement a common assessment tool to measure Bio REU program outcomes?

Roles:

*Facilitator:* Responsible for keeping the group on topic, ensuring every group member has the opportunity to contribute to the discussion, clarifying and summarizing key points of the discussion, and managing time so that both topics are addressed.

*Note taker:* Responsible for documenting the discussion key points and suggestions.

*Reporter:* Responsible for sharing the key points and suggestions with the large group.

Summary of large group discussion: The consensus among the attending REU PIs was that it was worth trying the URSSA and SURE common assessment surveys as a starting point, as long as PIs have the ability to customize and adapt them. However, there was also agreement that it is unlikely that there will be a survey that suits all REU sites equally well. The REU PIs debated whether there would be a distinction between student gains and student satisfaction, if the directive of the program is to get students into graduate school or to get them interested in science in another capacity, and how to best gather data on research experiences, scientific methods, and scientific communication. There was a great deal of concern about what metrics would be of value to the program at large, what represents success in the REU program, and what the control group should be. It was suggested that a leadership group establishes common assessment questions based on a website or listserv where PIs can submit questions.

### TOPIC #1 Training in Ethics and the Responsible Conduct of Research

Ethics and the responsible conduct of research (RCR) training is now **required** for all researchers funded by the National Science Foundation under the America COMPETES Act, including students participating in REU programs. Our conference pre-survey showed that many of you already include ethics training, although the type and extent of training varies. In addition, 63% of you indicated on the survey that you would be willing to develop and share ethics training materials with other REU programs if funded by NSF.

Discussion Questions:

1. What are the core topics that all Bio REU programs should cover in ethics and RCR training?

2. What are effective ways to implement ethics and RCR training as part of an REU program?
3. How can REU Program Directors effectively and efficiently document that students have completed training?
4. What types of resources should be posted on the Bio REU web site to support PIs in developing and implementing the training for their programs?
5. The NSF will be funding development of a National Ethics Resource Center (NSF 10-547, <http://www.nsf.gov/pubs/2010/nsf10547/nsf10547.htm?org=OMA>). What role can the Bio REU PIs and PDs play in the development of this Center? What kind of ongoing relationship might the Bio REU Leadership Council have with the Center once it is fully operational?

### Best Practices

#### **RCR – What core topics should be covered?**

1. Data management and sharing
  - a. Issues of how electronic data are managed, stored and manipulated.
2. Responsible authoring in publications
3. Working collaboratively
4. Peer reviewing
  - a. When is it appropriate and inappropriate for you to serve as a reviewer?
  - b. Constructive reviewing
5. The responsibility of the trainee
6. Responsibility of the scientist to society
7. Mentor-mentee relationship
8. Other aspects may be site-specific such as the use of animals and humans in research
9. Data gathering – rigorous / truthful = responsible
10. Ethics – what one does with the data
11. Data sharing and issues of ownership of data
12. Conflict of interest: e.g., who sponsors the research
13. Proper ways to collaborate (with other students, grad students, or mentor)
  - a. Faculty mentors will be their models (like it or not)
14. Look at the leadership alliance (<http://www.theleadershipalliance.org/>) for some reviews of several REUs across the country.

#### **RCR – Best practices for implementation?**

1. Flexibility must be maintained given the diversity of REU sites, however, some type of structured component was considered important.
2. No consensus was reached regarding the amount of time that should be spent in ethics training.
3. Documentation of what is done is important.
4. If RCR training is required it should be stipulated what is expected and that it has to be evaluated
5. Offer a certificate to students who complete the training
6. Leverage existing on-line tools
7. Employ a diversity of activities – different needs for different students
  - a. Case studies to illustrate issues to resolve; engage students in discussion
  - b. Presentation by an authority in bio ethics
  - c. Mentors be advised to discuss ethical issues with their students (mentor training)

## Recommendations

### **RCR – What might be helpful to post on the Website?**

1. Models that work.
2. Case studies or website where helpful case studies can be found.
3. List tools that are available that are known to work with undergraduate students
4. PIs would like guidelines regarding time / effort best spent of training
5. PIs would like funding for the class/workshop (speakers, supplies, etc.)
6. Effective documentation / assessment of RCR: many of us need more guidance on
  - a. Student surveys specifically about ethics at end of program (but mostly tests how students may have “appreciated” their ethics training)
  - b. Survey mentors at end of program (e.g. did you discuss ethical issues with your student? How frequently?)
  - c. Careful review of students’ notebooks (with student) during and at end
7. Posted resources
  - a. Case studies
  - b. Useful texts (e.g. “Entering Mentoring” book)
  - c. Enable REU List-Serv where questions / specific cases can be discussed
8. Role in development - National Ethics Resource Center
  - a. Include members of REU PIs to inform them of Bio (non-medical) issues
  - b. Function as an actual resource center where videos, texts, case studies,... can be obtained
  - c. Set up a section in the center specifically devoted to undergraduate issues
  - d. Create a 15 minute on-line course and/or video (basic course message); then REU programs can follow with specific issues, case studies
9. Need to be sure to have assessment built into RCR training to ensure that the training meets the goals of the program

### ***TOPIC #2 Common Assessment Tool to Measure Bio REU Outcomes (~ 40 minutes)***

In anticipation of the development of a freely available common assessment tool to measure Bio REU program outcomes, the NSF is no longer awarding assessment funds for REU site grants. The Bio REU Leadership Council needs your input to develop this tool. Our conference pre-survey showed that everyone is assessing the success of his/her program, but there is considerable variation in what we consider the most important measure of success.

#### Discussion Questions:

- Though Bio REU programs have varying goals/outcomes, what are some common goals/outcomes that all programs should aim to achieve?
- What are the major “types” of Bio REU programs (e.g. sub-discipline specific programs vs. broader discipline based programs; programs for first and second year students vs. graduate school preparatory programs for rising juniors and seniors)?
- What are some common goals/outcomes for each of these types of programs?
- What types of data would need to be collected to assess whether the goals/outcomes that your discussion group has identified have been achieved? What questions need to be asked?
- How would the common assessment tool be implemented?
- Which, if any, of the existing tools should we adopt? (e.g. SURE, <http://web.grinnell.edu/sureiii/>; URSSA, <http://spot.colorado.edu/~laursen/accessURSSA.html>)
- What will be the benefits and challenges of collecting common assessment data across programs?
- What issues of intellectual property rights do we need to consider?

- For what purposes might common assessment data from across programs be used?

### Best Practices

#### **Common assessment tool.**

1. Both the URSSA and SURE surveys measure appropriate outcomes and should be tried.
2. Programs are very diverse but all seek to provide students a realistic experience in basic research.
3. It would be helpful if comparisons among REU sites could be made so we could use these data to help improve our own programs.
4. It would be helpful if there was flexibility to add program specific questions (this is possible with URSSA).
5. Short and simple surveys are best to avoid annoying students.
6. How do we assess the quality of training?
7. Need to share best practices for assessment and consider a common tool or set of questions core goals or outcomes
8. What are some common achievement outcomes?
  - a. Using longitudinal studies: going to careers, grad school, etc.
  - b. Did the REU experience “change their mind”? .. about their plans.
  - c. Ask students to list positive (and negative) impacts in their own words.
9. What are the core goals of an REU program?
  - a. Empowered to make career decisions
  - b. Knowledge of science behind your questions
  - c. Competent communication
  - d. Graduate program?
  - e. Understanding of culture of science/scientific method
  - f. Building core workforce in science (research or other?)
  - g. Mixed messages – is it about producing PhDs, literate public? This is a big distinction and changes the evaluation of programs.
10. The restructuring of minority programs such as LS-AMP and TC programs means that we need to develop new strategies for ensuring underrepresented minority students have access to experiences

### Recommendations

1. SURE and URSSA have their strengths and weaknesses and we want to be sure that we maintain our unique identifies while also capturing the right kind of data
  - a. Recommend that the community of REU site directors be “polled” to develop common assessment tools
  - b. Leadership Committee should evaluate how well SURE and URSSA and other possible assessment tools conform to REU program needs
  - c. Web-site should contain samples of program evaluations provided by REU site directors to help new programs get started
2. Community needs it explicitly stated what is considered “success” so that it can be properly assessed by all programs
  - a. Leadership Committee can guide community to identify metrics of learning gains as opposed to “satisfaction” assessments
3. What are some common goals?
  - a. Concrete knowledge of scientific method

- b. Ability to understand, analyze and interpret data
- c. Pre- and post-test evaluation of ability to understand, analyze and interpret data
- 4. Benefits and challenges of collecting data across programs
  - a. Gives ability for PIs to strengthen their own programs
  - b. Supports efforts to sustain and grow REU program
  - c. Ability to track students longitudinally through a community resource would really be helpful for all programs
  - d. Main challenge is if we use a common tool who “owns” the data?
- 5. Community wants to support ability to leverage program assessments to secure funding but does not want cross-program evaluation data to be used to negatively review a program
- 6. It was agreed that there is a lack of solid assessment instruments for science programs. Therefore, REU programs should strive to use SURE and URSA to see if they are resilient enough for use with REU programs.

### PLENARY SESSION 3: REU Future Plans and Sustainability

**Speaker #1** – Dr. Alan Savitsky, NSF BIO/DBI Program Officer, “REU: Funding Trends, Renewals”

Recent funding data reveals that awards have become far more competitive over the last decade for the overall REU program. More proposals are being received and more funding is being requested. Many of the programs cannot be awarded the full amount that they proposed, but through budget negotiations, the NSF has been able to keep the rate of rewards relatively constant despite budget and application variations. In response to PI requests to include mentor stipends in the REU awards, Al explained that fulfilling this request would consume an entire BIO REU program budget.

Another highlight of Al’s presentation was how proposal renewals compete with new and excellent incoming proposals every year. Renewals are not assured, but the ones that are funded demonstrate program success and present new or innovative aspects to their renewal proposals. Roughly 40-60% of the total awards go to renewals. Supplemental funding is also available, however, ARRA funded sites cannot qualify for this funding. Opportunities for supplemental funding outside of REU’s budget include Research Assistantships for High School Students, Research Experiences for Teachers, and Research Opportunity Awards.

**Speaker #2** – Lida Beninson, NSF BIO REU Summer 2009 Intern

Since 2006, the NSF has gathered data on the Biology-funded REU sites to conduct a program wide evaluation to see trends and demands from the community. The highlights of this data illustrate that the total number of REU sites supported has increased from 108 in 2006 to 136 in 2009, the number of applications received increased from 13,857 to 21,038 in the same time period, and the acceptance rate dropped from 7.2% in 2008 to 5.1% in 2009, essentially making the REU program more difficult to get into than medical school. Although the data may not be completely reflective of REU’s competitiveness, since it is unknown how many of the applicants applied to more than one program, the data does illustrate that there is great student demand for undergraduate research opportunities in the biological sciences. The other highlight from this study is that the distribution of REU participants closely represents the distribution of the general population.

### **Speaker #3** – Jairo Pava, NSF Engineering REU Summer 2009 Intern

The BIO REU site is designed to serve the needs of the BIO REU community and includes current functionalities for students to locate a BIO REU site through geographic location. Also on-line is information for student travel support and other student opportunities. Over the coming year, through feedback from the BIO REU community additional functionality will be added. Students will be able to search for sites based on key words as well as location. Students will be able to contact site directors through the site. It is also possible to host a common application through the site. A series of links will be provided to guide PIs and mentors to best practices in mentoring, student recruitment, RCR training and assessment. PIs will be able to submit highlights through the site providing a way to share success throughout the community and also to allow NSF program officers to quickly identify highlights for internal submission. An electronic newsletter will be developed to inform the community of opportunities, best practices, etc. Discussion boards will also be set up to enable networking across the community.

### **Breakout Session #2**

Small groups of PIs discussed questions centered on plans for the future of the REU program. Breakout groups were charged with providing guidance on the following:

- 1) What community resources, common materials, tools etc. could be shared on the BIO REU website?
- 2) Are there assessment/evaluation aspects to the breakout topic that could be captured in a common assessment tool?
- 3) What community resources would enable REU programs to better serve students?

Roles:

*Facilitator:* Responsible for keeping the group on topic, ensuring every group member has the opportunity to contribute to the discussion, clarifying and summarizing key points of the discussion, and managing time so that both topics are addressed.

*Note taker:* Responsible for documenting the discussion key points and suggestions.

*Reporter:* Responsible for sharing the key points and suggestions with the large group.

### **Assessing outcomes for program improvement**

#### **Questions**

- What program-level outcomes (contribution to the field, publications, benefits to mentors or institutions, etc.) and/or program-level attributes (quality of offerings, satisfaction of mentors and/or participants, diversity of student applicants or participants) could or does your program measure?
- Which outcomes are most important and/or useful in helping improve the program, including advertising, recruitment, retention, training, etc.?
- What assessment methods and tools are most effective and efficient at gathering information for program improvement?
- How are results of assessments and evaluations used to improve the program ... prescriptively at the beginning of the program, in real time during the program, or retrospectively in shaping the next year's program?
- What, if any, mentor outcomes, attributes or practices are valuable to assess for program improvement, how do or might you assess these, and how do or might you use the information for program improvement?

- Are there questions that could be asked on a common assessment survey of REU students about the responsiveness of the program to pre- or mid-program feedback?
- What role can the LC and/or the BIO REU website play in supporting your program's efforts in the arena of formative assessment?

Best Practices for assessing outcomes for program improvement

**What program level outcomes and/or program-level attributes could you or do you monitor/assess?**

1. Contributions to the field
2. Benefits to mentors
3. Benefits to the field
4. Come to your graduate program
5. 2 yr to 4 yr
6. Publications/partners
7. Partnerships with external (to university) groups
8. Send to regional meeting where students present as part of grant
9. Attending national and regional meetings to give presentation – poster or oral
10. Final poster and oral presentations to university, public
11. Student awards
12. In some institutions, serving as mentor can influence tenure applications
13. General Outcomes: Publications, presentations at meetings, graduation, metrics that indicate becoming a “professional”, returning students (with other funding by mentors), tracking post-program, etc.
14. Holistic Outcomes: greater confidence, interest in science, feeling a part of a research team, but not so easily measured – and we should not ignore this.
15. Are students' thinking better at the end of the day...not necessarily only about the REU site scientific objectives example, molecular biology or microbial ecology, but really the big picture in science.
16. Student-research mentor interaction
17. Student-other mentors-group mentors (including faculty, graduate students, other undergraduate students) interaction and
  - a. Student-student interaction
  - b. This helps in social skills and also understanding of life as a scientist.
18. What have students learnt about themselves.
19. Some PIs have asked students write what their goals are at the beginning of the REU program, and then go back later at the end to review this.....this could be included in a survey.
20. An essay before the start of the program and administered again at the end of the program would be useful to obtain qualitative data....model is ETS's academic profile which has science questions.
  - a. Could be qualitative and quantitative.

**Which aspects are most important in helping improve the program?**

1. Satisfaction of interns, mentors
2. Evaluator – pre-assessment, mid-program focus group, end of program survey – several people
3. Surveys to gather information, sometimes anonymously
4. Bi-weekly progress reports
5. TA hired through program – lead weekly group meeting to discuss issues with mentors, PI, etc...not formal, written
6. Institutional level of REU assessment (several REUs), so improve program
7. Some of these are ephemeral and hard to measure

8. Attending and presenting at meetings got strong marks
9. Publications were not as strongly regarded.
10. Contrast between Entrance and Exit interviews: ratio of time spent doing research versus mandatory classes (e.g. ethics), training, etc.
11. Review outcomes in following autumn: PIs, co-PIs, coordinator (mentors present or not)
12. Regarding recruitment: useful to be able to ability to show prospective students past experiences: attended to scientific conferences or to have published their work, this impresses potential students and the instructors at target schools

**Which assessment methods and tools are most effective and efficient at gathering information for program improvement?**

1. PR on awards
2. Student suggestions
3. Student comments leading to exclusion of a mentor How recruitment pool reflects recruitment strategies and how to improve, site visits
4. Bring past REU interns in to talk with interns – satisfaction increase in current interns
5. Open focus group with someone not associated with program, minus PI, so feel free to talk, anonymously report back to PI
6. External review committee – meet with students
7. Early and late program focus groups - e.g., more social activity interaction with mentors – make changes
8. Written surveys
9. Requirements for mentors in order to be chosen for a mentor – e.g., if gone too much, etc., possibly co-mentor
10. Recognition from year to year of ups and downs of program desires, etc.
11. Interview questions – modified from before
12. Mid-program presentations provides insights on how things are doing
13. Site visits
14. How deal with disruptive students
  - a. Fines - \$500
  - b. Meeting with interns
  - c. Contract with interns – set expectations in paper
15. Exit surveys are common: effective but not especially efficient; often done 1-on-1?
16. Mid or early, or weekly during the program may employ the coordinator or a grad student (e.g. at a lunch)
17. Some concerns or issues exit when interviews competed by the PI and/or mentors, especially if there may have been a problem or concern with a student
18. Using a focus-group assessment (based on HHMI model), employs an external reviewer (cost associated with that) or the coordinator
19. An informal group discussion with some or all the students

**How are results of evaluation used to improve program**

1. Don't let inmates run asylum...ask for input, but not react to every one
2. Educational events that also serve as social events
3. Optional weekend events – some optional, some required
4. Some programs – all required – all organized events
5. Access to housing –
  - a. creates a different dynamic if not all together

- b. but if going to connect with non-traditional, harder
- 6. Pre-assessments may assist in the on-the-fly adjustments.
- 7. Students a list of topic or classes (□15 topics): ask students which they think are most important to them; do a subset. Ethics would not be a matter of choice.
- 8. Coordinators are a big help to observe (“sneak attacks”): randomly observe what they are doing, and even speak to the students; e.g., “how is it going?”
- 9. Pre-Assess (just before arriving: Survey monkey given to students, they are told it is used to help their mentor: to explain their expectations regarding their level of mentoring, lab time, etc. They are told that mentors will be getting their expectations. Then this is shared with mentors.

**What if any mentor outcomes do you use to improve the program**

- 1. feedback of intern – not work with mentor
- 2. assess availability of mentor – for use in summer
- 3. evaluations by mentors of program
- 4. This was seen as difficult: some programs have a limited pool.
- 5. Some felt it may be negative, but many felt more positive: many are intangibles (job satisfaction), assist them in moving their own research forward,
- 6. Several suggested a partnered labs to ensure an adequate and successful mentoring
- 7. Simply asking mentors what are the benefits they are getting; follow-up comments are impressions of their experiences
- 8. Random visits with students, at lab meetings, during the program by a coordinator
- 9. Informal meetings may be most effective, but not easily assigned to a metric.

**Are there questions that could be asked of REU students about the responsiveness in a common assessment tool to create common program feedback about responsiveness of program?**

- 1. Mid-program – to identify problems, etc.
- 2. Questions:
  - a. If there were any problems, were you needs addressed.
  - b. Did intern take an active role in solving situation
  - c. Did you have an issue with the curriculum? Was it addressed? What role did you take?
  - d. Did you feel you could talk with PI about issues?
- 3. Did you encounter a problem while at your REU program? ...or in your research experience?
- 4. Did you feel that you could take problems to your mentors or the coordinator?
- 5. If changes were needed – were those changes made?
- 6. Did the program match your expectations for research experiences?
- 6. Did you actually play a role in generating hypotheses, making a research plan, conducting independent research...?
- 7. Did you have an opportunity to present (and/or how many times)

Recommendations

**What role can REU website or LC help in formative evaluations?**

- 1. Copies of student contracts groups use
- 2. Case studies of how issues have been dealt with
- 3. What does LC Do? Need to clarify role of LC and how it interacts with the BIO REU community beyond organizing meetings.
- 4. The website could give examples of how programs have handled issues well or have not worked – to serve as a guide.
- 5. Core questions are fine – but flexibility is necessary.

6. Ask PIs to suggest their most important questions in a survey: the LC may need to see how wide diversity of needs
  - a. Pre- and midterm assessments may be the most difficult to standardize (common tool) currently; gathering experiences and identify resources to improve one's own assessments.
7. The match between quantitative and qualitative assessments is not always strong; this suggests that qualitative measures are important and useful.
  - a. A question was also raised if there could be too many surveys 3, 4 or even 6 assessments (survey fatigue).
8. Individual program newsletters and BIO REU program wide newsletter to help track students

### *Assessing outcomes for undergraduate research learning gains*

#### **Questions**

- What student outcomes – student learning, skill development, career knowledge/motivation/self efficacy, social connections or networks, products – are most interesting or important to assess?
- What are the most effective and efficient methods for assessing these outcomes?
- How much are programs allocating, in terms of time and money, to doing assessment, and is this adequate or too much?
- Which long-term outcomes are most valuable and what are the best methods for assessing these? What kinds of longitudinal or long-term studies can or should we be doing to follow students into their careers? How long are programs tracking students?
- Is it worthwhile to have a “control”, “outgroup”, or benchmark comparison to assess program impacts? Should this be developed individually for each program? What other ways are effective at attributing student outcomes to our programs in general and/or to specific program components or aspects in particular?
- What new tools – e.g., social networking sites, etc. – can we use to accomplish a combination of sustained support and interaction, and long-term monitoring of student attainment?
- How can use of a program-wide student assessment system provide useful knowledge about student learning and professional development?
- What role can the LC and/or the BIO REU website play in supporting your program's efforts in the arena assessing student outcomes?

### *Community Resource Development*

#### **Questions**

- How can we work collectively to share and leverage best practices to the benefit of the REU program as a whole?
- In addition to periodic BIO REU PI meetings, what other networking mechanisms can we use to engage and support site directors and research mentors?
- What roles can professional societies play in community development and support of REU programs, students, mentors and leaders?
- What kind of tools would help you fulfill the new ethics requirements?
- Should more support/information be provided to international programs?

### Best Practices

1. Sharing best practices
  - a. Website
    - i. Share electronic application materials (through website)

1. Possible to use one general application for all summer programs at an institution
  2. a single REU form may not work for multiple summer programs at a single site
  - ii. Specific application include:
    1. Essay: why genetics? Why ecology?
    2. Who do you want to work for?
    3. Targeting – freshman, first generation students, area of interest
      - a. Participation of diverse student groups
    4. Searchable applications for the categories
    5. Helpful to new programs with specific needs (e.g., computational biology)
  - b. Community resources should include our recruitment targets
  - c. Information useful to you
    - i. Supplemental funding
      1. Availability of funding sources
      2. NSF opportunities
      3. Other sources
    - ii. Funding mentor stipends
      1. Sources of funding
    - iii. Reach undergraduate coordinators for recruitment
      1. Network of site coordinators
    - iv. Network of program PIs – share minority applications, tribal college, single mother with dependents/families, requirement for local REU, additional facilities
  - d. Sharing applications
    - i. Sub-network of ecological applications or other specific areas
      1. “unused” applications can be referred to other REUs
      2. Identify underrepresented minority applicants quickly to ensure they are captured in the participant pool
2. Recruiting
    - a. Work through undergraduate coordinators
    - b. Best recruiting is visit to target institution
      - i. show up often (tribal college suggestion)
    - c. Website for virtual connections – possible
  3. To reward mentors, institutions could convert “teaching” hours to service house for recruitment

### Recommendations

1. Develop a program of “REU ambassadors” for regional recruiting
  - a. Grant to support 5 years (long-term appointment critical to continuity of program)
  - b. Travel in region and recruit for all REUs in region
  - c. Could have a national coordinator “Director of Education Programs” long term appointment
    - i. Other responsibilities and funding
  - d. Attends national meetings

2. Use of “linked in” for recruiting – computer network of professionals.
  - a. Start discussion groups, describe your REU for search purposes
  - b. There is limited funding for recruitment – would be good to see supplemental funding for this purpose
3. Leverage professional societies
  - a. Leadership Committee can initiate linkages with societies and get them listed on the BIO REU website
4. International programs are of importance to the REU experience
  - a. Access to international students
  - b. Exchange programs
  - c. US students and foreign counterparts
5. Regional workshops – undergraduate research networking on a yearly basis rather than national meeting (possible cost savings?)
6. Share stories of successful recruitment connections on website or blog
7. Importance of relationship building to recruitment efforts
  - a. Numerous contact and serious commitment critical
  - b. Interns to manage stories
  - c. Linked-in could be helpful

### ***REU “Action Plan”***

#### **Questions**

- What strategies can be used to recognize excellence in student mentoring?
- What strategies can be used to recognize student growth, attainment and achievement through the REU program?
- What are the most important resources that could be posted on the BIO REU Website, and who should produce and maintain these?
- What should be the roles and responsibilities of the BIO REU Leadership Council?
- How can we best implement, monitor, benefit from and improve program-wide assessment tools and ethics components?

The above session recommendations are summarized within other discussions and so are not broken out here. For overarching recommendations see the Recommendations to the LC.

**Table 3.** Contact information for registrants. Highlighted in Yellow are LC members and Workshop Co-Chair (Christian). The BIO REU 2010 workshop was sponsored by a grant to Hannigan and Christian (NSF DBI- 1019365).

<b>Last Name</b>	<b>First Name</b>	<b>Email</b>	<b>University/Organization</b>
Allison	Richard	allison@msu.edu	Michigan State University
Anderson	Diana	danderso@nsf.gov	NSF
Anderson	Cort	cla@uidaho.edu	University of Idaho
Aoki	Chiye	ca3@nyu.edu	New York University
Ayoub	Joseph	jayoub@pitt.edu	University of Pittsburgh
Barcnas	Nina	barcnas_n@heritage.edu	Heritage University
Barney	Chris	barney@hope.edu	Hope College
Barthell	John	jbarthell@uco.edu	University of Central Oklahoma
Battelle	Barbara	battelle@whitney.ufl.edu	University of Florida
Bennett	Timothy	bbennett@ndatc.org	ND Assn of Tribal Colleges
Bennett	George	gbennett@rice.edu	Rice University
Berg	David	bergdj@muohio.edu	Miami University
<b>Berkowitz</b>	<b>Alan</b>	<b>berkowitza@caryinstitute.org</b>	<b>Cary Institute of Ecosystem Studies</b>
<b>Billick</b>	<b>Ian</b>	<b>ibillick@rmbll.org</b>	<b>Rocky Mtn. Bio. Lab</b>
Billiot	Eugene	eugene.billiot@tamucc.edu	Texas A&M University-Corpus Christi
Blockus	Linda	blockusl@missouri.edu	University of Missouri
Blum	Paul	pblum1@unl.edu	U. Nebraska-Lincoln
Bolden-Tiller	Olga	obtiller@tuskegee.edu	Tuskegee University
Bosland	Paul	pbosland@nmsu.edu	New Mexico State University
Bourgeron	Patrick	psbourgeron@plymouth.edu	Plymouth State University
<b>Branchaw</b>	<b>Janet</b>	<b>branchaw@wisc.edu</b>	<b>University of Wisconsin - Madison</b>
Bridges	Susan	bridges@cse.msstate.edu	Mississippi State University
Bucking	Heike	heike.bucking@sdstate.edu	South Dakota State University
Burgess	Robert	robert.burgess@jax.org	The Jackson Laboratory
Burnett	Karen	burnettk@cofc.edu	College of Charleston
Carson	Susan	sue_carson@ncsu.edu	North Carolina State University
Chigbu	Paulinus	pchigbu@umes.edu	University of Maryland Eastern Shore
Chopin	Suzzette	suzzette.chopin@tamucc.edu	Texas A&M University-Corpus Christi
<b>Christian</b>	<b>Alan</b>	<b>alan.christian@umb.edu</b>	<b>UMass Boston</b>
Cloninger	Mary	mcloninger@chemistry.montana.edu	Montana State University

<b>Last Name</b>	<b>First Name</b>	<b>Email</b>	<b>University/Organization</b>
Collins	Scott	scollins@sevilleta.unm.edu	University of New Mexico
Craig	Sean	sfc4@humboldt.edu	Humboldt State University
Creamer	Trevor	trevor.creamer@uky.edu	University of Kentucky
Darling	Daniel	ddarling@mit.edu	M.I.T.
Dayrat	Benoit	bdayrat@ucmerced.edu	University of California at Merced
Dhir	Sarwan	dhirs0@fvsu.edu	FORT VALLEY STATE UNIVERSITY
Didier Dagit	Dominique	ddagit@millersville.edu	Millersville University
Dighton	John	dighton@camden.rutgers.edu	Rutgers University
Domingo	Carmen	cdomingo@sfsu.edu	San Francisco State University
Donaldson	Robert	robdon@gwu.edu	George Washington Univ
Dorn	Lisa	dorn@uwosh.edu	University of Wisconsin Oshkosh
Dotson	Cherie	crdotson@umich.edu	University of Michigan
Doze	Van	vdoze@medicine.nodak.edu	University of North Dakota
Eaton	William	weaton@kean.edu	Kean University
Ellison	Aaron	aellison@fas.harvard.edu	Harvard University
Ely	Bert	ely@sc.edu	University of South Carolina
Evans-White	Michelle	mevanswh@uark.edu	University of Arkansas
Faulkes	Zen	zfaulkes@utpa.edu	The University of Texas-Pan American
Galbraith	Anne	galbrait.anne@uwlax.edu	Univ of Wisconsin La Crosse
Gamble	Tony	gambl007@umn.edu	University of Minnesota
Gilmore	Thomas	gilmore@bu.edu	Boston University
Green	Joel	jgreen@nwic.edu	Northwest Indian College
Guinn	Jeremy	jeremyg@sbc.edu	Sitting Bull College
Gurley	William	wgurley@ufl.edu	University of Florida
Hamilton	Wendy	whamilto@nmsu.edu	New Mexico State University
<b>Hannigan</b>	<b>Robyn</b>	<b>robyn.hannigan@umb.edu</b>	<b>UMass Boston</b>
Hass	Carla	cah19@psu.edu	Penn State
Heinz	Kevin	t-gold@tamu.edu	Texas A&M University
Hicks	Leslie	lhicks@danforthcenter.org	Donald Danforth Plant Science Center
Hines	Anson	hinesa@si.edu	Smithsonian
Honeycutt	Rodney	rodney.honeycutt@pepperdine.edu	Pepperdine University
James	Brozik	brozik@wsu.edu	Washington State University
Jander	Georg	gj32@cornell.edu	Boyce Thompson Institute
Johnson	Jennifer	jjohnson@sevilleta.unm.edu	University of New Mexico
Judelson	Howard	howard.judelson@ucr.edu	University of California

<b>Last Name</b>	<b>First Name</b>	<b>Email</b>	<b>University/Organization</b>
Kalavacharla	Venu	vkalavacharla@desu.edu	Delaware State University
Keithly	Janet	keithly@wadsworth.org	SUNY Albany/Wadsworth Center
Kelley	Patricia	kelleyp@uncw.edu	University of North Carolina Wilmington
Kimball	Kristen	kristen.kimball@uconn.edu	University of Connecticut
Kunkel	Gary	g-kunkel@tamu.edu	Texas A&M University
Laybourn	Paul	paul.laybourn@colostate.edu	Colorado State University
Lippman	Zachary	lippman@cshl.edu	Cold Spring Harbor Laboratory
Lopatto	David	lopatto@grinnell.edu	Grinnell College
Martins	Emilia	emartins@indiana.edu	Indiana University, Bloomington
Matlack	Ray	rmatlack@wtamu.edu	West Texas A&M University
<b>Matlock</b>	<b>Marty</b>	<b>mmatlock@uark.edu</b>	<b>University of Arkansas</b>
McCartney	Brooke	bmccartney@cmu.edu	Carnegie Mellon University
McKernan	Michael	mmckernan@mdibl.org	Mount Desert Island Biological Laboratory
Meagher	Richard	meagher@uga.edu	University of Georgia
Miller	Kathryn	miller@wustl.edu	Washington University, St. Louis
Mitchell	Randy	rjm2@uakron.edu	University of Akron
Mohr	Christian	mohrx005@umn.edu	University of Minnesota
Mooi	Rich	rmooi@calacademy.org	California Academy of Sciences
Morris	Sherri	sjmorris@bradley.edu	Bradley University
Moss	Elica M.	elica.moss@aamu.edu	Alabama A&M University
Mukhopadhyay	Biswarup	biswarup@vt.edu	Virginia Polytechnic Institute and State University
Nagy	Eric	enagy@virginia.edu	University of Virginia
Neudorf	Diane	neudorf@shsu.edu	Sam Houston State University
O'Connor	Sally	soconnor@nsf.gov	NSF
O'Day	Peter	oday@uoregon.edu	University of Oregon
O'Toole	George	georgeo@dartmouth.edu	Dartmouth
Overstreet-Wadiche	Linda	lwadiche@uab.edu	UAB
Oyarzabal	Omar	ooyarzabal@alasu.edu	Alabama State University
Pava	Jairo	jpava001@fiu.edu	Florida International University
Pearce	David	pearced@sanfordhealth.org	Sanford Research
Pelczer	Istvan	ipelczer@princeton.edu	Princeton University
Pfeiffer	David	afdc@uaa.alaska.edu	University of Alaska Anchorage

<b>Last Name</b>	<b>First Name</b>	<b>Email</b>	<b>University/Organization</b>
Pologruto	Dawn	dpologru@cshl.edu	Cold Spring Harbor Laboratory
<b>Powell</b>	<b>Robert</b>	<b>robert.powell@avila.edu</b>	<b>Avila University</b>
Puffenbarger	Robyn	rpuffenb@bridgewater.edu	Bridgewater College
Pullin	Michael	mpullin@nmt.edu	New Mexico Tech
Ramirez	Alonso	aramirez@ites.upr.edu	University of Puerto Rico
Rangachari	Vijay	vijay.rangachari@usm.edu	University of Southern Mississippi
Rao	Sujaya	sujaya@oregonstate.edu	Oregon State University
Richardson	Ginger	grr@santafe.edu	Santa Fe Institute
Risch	Thomas	trisch@astate.edu	Arkansas State University
Robleto	Eduardo	eduardo.robleto@unlv.edu	UNLV
Romani	Andrea	amr5@po.cwru.edu	Case Western Reserve University
Rothschild	Max	mfrothsc@iastate.edu	Iowa State University
Roulston	Tai	thr8z@virginia.edu	University of Virginia
Running	Mark	mrunning@danforthcenter.org	Donald Danforth Plant Science Center
Sahi	Shivendra	shiv.sahi@wku.edu	Western Kentucky University
Sancar	Esta	gwendolyn_sancar@med.unc.edu	UNC-Chapel Hill
Savitzky	Alan	asavitzk@nsf.gov	NSF
Sayes	Christie	csayes@cvm.tamu.edu	Texas A & M University
Schildbach	Joel	joel@jhu.edu	Johns Hopkins University
Schottel	Janet	schot002@umn.edu	University of Minnesota
Scott	Maya	msscott@cvm.tamu.edu	Texas A&M University
Sherman	Tim	tsherman@jaguar1.usouthal.edu	Univ. of South Alabama
Sierwald	Petra	psierwald@fieldmuseum.org	Field Museum of Natural History
<b>Simcox</b>	<b>Amanda</b>	<b>simcox.1@osu.edu</b>	<b>Ohio State University</b>
Skvirsky	Rachel	rachel.skvirsky@umb.edu	UMass Boston
Snyder	Bruce	basnyder@ksu.edu	Kansas State University
<b>Soto</b>	<b>Julio</b>	<b>jsoto3@email.sjsu.edu</b>	<b>San Jose State University</b>
Spitsbergen	John	john.spitsbergen@wmich.edu	Western Michigan University
Spragg	Jocelyn	jocelyn_spragg@hms@harvard.edu	Harvard University
Stabb	Eric	estabb@uga.edu	University of Georgia
Starks	Philip	philip.starks@tufts.edu	Tufts University
Stone	Julie	jstone2@unl.edu	University of Nebraska - Lincoln
Strychar	Kevin	kevin.strychar@tamucc.edu	Texas A&M University - Corpus Christi
Stynoski	Jennifer	stynoski@gmail.com	Organization for Tropical Studies

<b>Last Name</b>	<b>First Name</b>	<b>Email</b>	<b>University/Organization</b>
Tamone	Sherry	sltamone@uas.alaska.edu	University of Alaska Southeast
Taylor	Stephen	staylor@desu.edu	Delaware State University
Thomas	Richard	rthomas@wvu.edu	West Virginia University
Tolbert	Blanton	tolberbs@muohio.edu	Miami University
VanderGheynst	Jean	jsvander@ucdavis.edu	UC Davis
Ventrello	Barbara	barbarav@santafe.edu	Santa Fe Institute
Vess	Tomalei	tomalei.vess@duke.edu	Duke
Wang	Yong	wang.aamu@gmail.com	Alabama A&M University
Warburton	Louise	lwarburton@chicagobotanic.org	Chicago Botanic Garden
Waring	Gail	gail.waring@marquette.edu	Marquette University
Wehr	John	wehr@fordham.edu	Fordham University
Weisblat	David A.	weisblat@berkeley.edu	Univ. of Calif., Berkeley
Weiss	David	david-weiss@uiowa.edu	The University of Iowa
West	Jennifer	jwest@rice.edu	Rice University
Westlie	Tara	tara.westlie@umontana.edu	The University of Montana
Whaley	Michelle	whaley.3@nd.edu	University of Notre Dame
Whipple	Amy	amy.whipple@nau.edu	Northern Arizona University
Wilson	Alan	wilson@auburn.edu	Auburn University
Woodson	Donald	donald.woodson@ucsf.edu	University of California San Francisco
Younos	Tamim	tyounos@vt.edu	Virginia Tech
Ziegler-Chong	Sharon	ziegler@hawaii.edu	University of Hawaii at Hilo